

Look at 2^x

$2^0 = 1$	$\ln 2 = .69$	2^x
$3^0 = 1$	$\ln 3 = 1.098$	3^x
$e^0 = 1$	$\ln e = 1$	e^x
$4^0 = 1$	$\ln 4 = 1.39$	4^x

2nd draw tangent
find slope
of tangent
at $x=0$

slope
1.39 2^x at $x=1$
3.296 3^x
5.545 4^x
2.718 $-e$ e^x

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(2^x) = \ln 2 \cdot 2^x$$

$$\frac{d}{dx} b^x = (\ln b) b^x$$

$$\begin{aligned} & (e^{\ln 2})^x \\ &= e^{x \ln 2} \\ \frac{d}{dx} (e^{x \ln 2}) &= (e^{x \ln 2}) (\ln 2) \\ &= (2^x) (\ln 2) \end{aligned}$$

$$\frac{d}{dx}(e^x) = e^x$$

$$e^{\ln x} = x$$

$$\frac{d}{dx}(e^{\ln x}) = \frac{d}{dx}(x)$$

$$(e^{\ln x}) \left(\frac{d}{dx}(\ln x) \right) = 1$$

$$\star \frac{d}{dx}(\ln x) = \frac{1}{e^{\ln x}} = \frac{1}{x}$$

$$\text{familiar with } \frac{d}{dx}(\log_b x) = \frac{1}{x \ln b}$$

Common confusion

Do not read below
this line

$$\frac{d}{dx} x^n = nx^{n-1}$$

$$\frac{d}{dx} e^x = e^x$$

$$\frac{d}{dx} 17^x = (\ln 17) 17^x$$

\ln (base)	slope @ $x=1$	slope @ $x=0$	Consider	f'_e $x=0$	f'_e $x=1$	use 2 nd draw tangent to find the slope of the tangent line at $x=1$ & $x=0$
$\ln 2 = .693$	1.386	.693	$y = 2^x$	1	2	
$\ln 3 = 1.098$	3.295	1.098	$y = 3^x$	1	3	
$\ln 4 = 1.386$	5.545	1.386	$y = 4^x$	1	4	
$\ln e = 1$	2.718 = e	1	$y = e^x$	1	$e = 2.718$	

$$\therefore \frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(2^x) = \frac{d}{dx}\left((e^{\ln 2})^x\right) = \frac{d}{dx}(e^{x \ln 2})$$

$$\begin{aligned}
 &= (e^{x \ln 2}) \left(\frac{d}{dx}(x \ln 2) \right) \\
 &= (e^{x \ln 2}) (\ln 2) = (\ln 2) 2^x
 \end{aligned}$$

$$\begin{aligned}
 &e^{x \ln 2} \\
 &= e^{\ln(2^x)} \\
 &= 2^x
 \end{aligned}$$

$$\therefore \frac{d}{dx}(b^x) = (\ln b) b^x$$

$$\frac{d}{dx} e^x = e^x$$

$$\frac{d}{dx}(e^{\ln x}) = \frac{d}{dx}(x) = 1$$

$$(e^{\ln x}) \left(\frac{d}{dx}(\ln x) \right) = 1$$

$$x \frac{d}{dx}(\ln x) = 1$$

$$\frac{d}{dx}(\ln x) = \frac{1}{x}$$



$$\frac{d}{dx}(\log_2 x) =$$

$$= \frac{d}{dx} \left(\frac{\ln x}{\ln 2} \right)$$

$$= \frac{1}{\ln 2} \left(\frac{d}{dx}(\ln x) \right)$$

$$= \frac{1}{x \ln 2}$$

$$\frac{d}{dx} \log_b x = \frac{1}{(\ln b)x}$$

